BULLETIN

OF THE INSTITUTE OF METALS

VOLUME 2 MARCH 1954 PART 7

INSTITUTE NEWS

War Office Representative

Major-General W. A. Lord, C.B.E., has succeeded Major-General S. W. Joslin, C.B.E., M.A., as representative of the War Office at Council meetings.

The W. H. A. Robertson Medal and Premium

The W. H. A. Robertson Bronze Medal and a Premium of Fifty Guineas are awarded annually by the Council to the author or authors of the paper adjudged to be of the highest merit contributed to the *Journal of the Institute of Metals* on engineering aspects of non-ferrous metallurgy. No award is made if, in the Council's opinion, no paper published during the year is of sufficient merit to justify the award.

The award is open to persons of any nationality and of either sex, and to non-members as well as to members of the Institute. MSS. of papers should be addressed to the Secretary of the Institute in the normal way. All published papers are considered for the award annually by the Medal Committee, with the advice of the Metallurgical Engineering Committee.

The medal and award are placed at the disposal of the Council by the Directors of W. H. A. Robertson and Co., Ltd., of Bedford, who, having in mind the few papers contributed to the *Journal* dealing with the engineering side of non-ferrous metal production, and believing that such papers would be to the advantage of the Institute and the industry, offered the sum of £100 a year, for a period of not less than seven years, to stimulate the writing of papers of this kind.

The objects which the donors had in mind are warmly approved by the Council, which hopes that the awards will stimulate the submission of such papers for publication by the Institute. The Metallurgical Engineering Committee will be grateful to members of the Institute if they will encourage suitable members of their staffs to submit papers of a high standard for the consideration of the Publication Committee.

Election of Members

The following 13 Ordinary Members, 1 Junior Member, and 6 Student Members were elected on 25 January 1954:

As Ordinary Members

Alexander, Milton Judson, B.S., Chief Metallurgist, Quaker State Metals Company, Box 1138, Lancaster, Pa., U.S.A.

Bawcutt, John, General Manager, Rhodesian Cables, Ltd., P.O. Box 1567, Salisbury, Southern Rhodesia.

Kawashima, Namio, D.Eng., Factory Superintendent, Toyo Aluminium K.K., 4-chome, Minamikyutaromachi, Higashiku, Osaka, Japan.

Leitch, George Geoffrey, Chief Metallurgist, Fellows Gear Shaper Company, Springfield, Vt., U.S.A.

Lycett, Willis Frederick, Metallurgist, Department of Research and Technical Development, Stewarts and Lloyds, Ltd., Bilston, Staffs.

Mima, *Professor* Genjiro, Dr.Tech., Professor of Metallurgy, Faculty of Engineering, Osaka University, Osaka, Japan.

Nielsen, John P., Ph.D., Associate Professor of Metal Science, College of Engineering, New York University, New York 53, N.Y., U.S.A.

Pashley, Percy Raymond, Steel Works Chemist and Works Manager, Kiveton Park Steel and Wire Works, Ltd., Kiveton Park, near Sheffield.

Rawbone, Francis Joseph, Works Director, Plastic and Metal Industries (Pty.), Ltd., P.O. Box 1821, Johannesburg, Transvaal, South Africa.

Sato, Mizuho, D.Sc., Sato Laboratory, Scientific Research Institute, Bunkyoku, Komagome, Kamifujimaecho 31, Tokyo, Japan.

Schmidt, Raymond, Ph.D., Chief Analyst, N.V. Algemeene Kunstzijde Unie, Velperweg 76, Arnhem, Netherlands.

Tani, *Professor* Yasumasa, Dr.Eng., M.A., Professor of Applied Physics (Metal Physics), Institute of Industrial Science, University of Tokyo, Chiba City, Tokyo, Japan.

Wilson, William Thomas, B.Sc., A.I.M., Chief Metallurgist, Modern Hardmetals, Ltd., Don Road, Sheffield 9.

As Junior Member

Teague, Cecil John, B.Sc., Research Assistant, Research Laboratory, James Booth and Co., Ltd., Nechells, Birmingham 7.

As Student Members

Drake, John Brian, Undergraduate, University of Cambridge.

Larcombe, Basil, Research Metallurgical Chemist, Brown-Firth Research Laboratories, Princess Street, Sheffield.

Patten, Keith David, Undergraduate, King's College, University of Durham, Newcastle-on-Tyne.

Scott, Michael Harvey, Undergraduate, University of Cambridge.

Singh, Surindar, Student of Metallurgy, County Technical College, Wednesbury, Staffs.

Talim, Vasant Trimbak, B.Sc., Student; (mail): 19 Woodside, Wimbledon, London, S.W.19.

PERSONAL NOTES

Dr. F. P. Bowden has been awarded the Redwood Medal of the Institute of Petroleum.

Mr. J. V. Chatterton has been appointed Foundry Engineer in the Special Projects Department of Cincinnati Milling Machines, Ltd., Birmingham.

Mr. V. Delport has relinquished his post as Managing Director of the Penton Publishing Co., Ltd., after holding it for 30 years. He will retain his connection with the Company as Director and Treasurer and will continue his activities as representative of *Foundry* and other Penton journals.

Mrs. E. F. Dunlop is retiring and leaving Hong Kong to take up residence in Canada.

Mr. A. I. Eckersall has been appointed Time Study Officer at the National Smelting Co., Ltd., Avonmouth.

Mr. F. Howitt has relinquished the position of Technical Superintendent and Deputy Manager of the Northern Aluminium Company's foundry and forge at Birmingham on being transferred to the Aluminium Company of Canada, Ltd., Montreal.

Mr. K. G. Latimer has taken up an appointment with The David Brown Foundries Co., Ltd., Penistone.

Dr. D. H. Locke has left the University of Birmingham and is now employed in the Research and Development Branch of the Atomic Energy Department near Preston. He has been awarded the Ph.D. degree for his work at Birmingham.

Mr. A. R. Martin has been appointed Chief Metallurgist to the Northern Aluminium Co., Ltd., Handsworth, Birmingham. He was previously Works Metallurgist.

Mr. T. J. Peake has been transferred from Aluminium Laboratories, Ltd., to its associate company, Northern Aluminium Co., Ltd.

Dr. W. A. Rachinger is now working at the Metallurgy Department, University of Birmingham.

Mr. E. G. Spooner has returned from India and his address is now c/o Whitehead Iron and Steel Co., Ltd., Newport, Mon.

Mr. W. H. Tait, Technical Director of the Glacier Metal Co., Ltd., has retired from the board, but is continuing to serve the Company in a technical capacity.

Mr. G. M. Taylor is now with The Drayton Regulator and Instrument Co., Ltd.

Mr. W. K. L. Thomas has been awarded the M.Sc. degree of London University and the Diploma of Imperial College.

Mr. E. V. Tull has been awarded the M.Sc. degree of the University of Wales.

Mr. Hill W. Worner has been awarded the D.Sc degree of Melbourne University. His published work has dealt with the structure and properties of lead alloys and with the preparation, properties, and alloying of titanium.

PERSONALITIES

Dr. Leslie Aitchison

(Institute of Metals (Platinum) Medallist 1954)

Leslie Aitchison was a student under Professor J. O. Arnold in the Metallurgical Department at Sheffield University, and after graduation was awarded a Research Fellowship at Sheffield. He then served in the steel industry for a short time, afterwards returning to Sheffield University as lecturer and demonstrator in metallurgy. During the next few years he published a number of papers, dealing mainly with his research on corrosion problems, and was awarded the D.Met. degree for this work. He also collaborated with the late Dr. F. Ibbotson in writing "The Analysis of Non-Ferrous Alloys", a text-book which was very widely adopted.

During the First World War, Dr. Aitchison was commissioned as Lieutenant, R.N.V.R., being appointed to the Air Division, and thus began his long association with aeronautics

and aeronautical materials. He worked in the technical section of the Royal Naval Air Service, and when this service was fused with the Royal Flying Corps, he became the metallurgist to the Air Board and later, on its creation, to the Air Ministry. After the end of the war, the Air Ministry retained him as consultant on metallic materials, a position which he held until 1924. In the same period, he acted as consultant to various aircraft and aero-engine builders, as well as to drop-forgers and automobile manufacturers. During these years, he was very intimately engaged in the preparation of British Standard Specifications for all types of metallic materials. He was concerned mostly with those for aircraft and automobiles, and was Chairman of a large number of the committees of the British Standards Institution dealing with steel, light alloys, and other non-ferrous materials. In this same period, he was closely associated also with the Aeronautical Research Committee, an association which still continues.

In 1924, Dr. Aitchison became Superintendent of the Company to James Booth and Co., Ltd., of Birmingham. He held this position for twenty years and was intimately concerned with the striking growth of the light alloy industry in this country. During his connection with it, the industry made phenomenal strides and multiplied its production and capacity many times. When the Wrought Light Alloys

Association was formed in 1937, he was appointed Chairman of its Executive Committee as well as of its Technical Committee, and he held both these positions until he retired from industrial service. During all the time he was with James Booth and Co., Ltd., he continued active work in connection with standardization, though naturally concentrating his attention on non-ferrous materials, both heavy and light.

In 1944, Dr. Aitchison, for reasons of health, was compelled to retire from active work in industry and, after a time, became a Fellow of Birmingham University, where he devoted himself to the development of the teaching of Industrial Metallurgy. This was a new departure in academic circles, and the University of Birmingham came to think so well of it that a Chair of Industrial Metallurgy was founded of which Dr. Aitchison became the first occupant. He was compelled to relinquish this position because of ill-health in 1949.

In addition to his membership of a number of committees of the Aeronautical Research Council and the Department of Scientific and Industrial Research, he has been closely associated with official metallurgical research in connection with aeronautics and air service. When the Government decided to establish the Inter-Service Metallurgical Research Council, Dr. Aitchison became the first Chairman, and took a considerable part in launching this new and important venture. In 1947 he was appointed Chairman of the Joint Committee on Metallurgical Education, to which he rendered outstanding service.

During Dr. Aitchison's period as consultant after the first war, he published his well-known text-book on "Engineering Steels", and, with the late Mr. W. R. Barclay, a corresponding volume on "Engineering Non-Ferrous Metals and Alloys". He published a considerable number of papers in that same period, many of them dealing with his original work on fatigue. Since retiring from the Chair of Industrial Metallurgy, he has published three more books, all relevant to the work of his Department at Birmingham University. "Introduction to Industrial Metallurgy" appeared in 1949; both "The Casting of Non-Ferrous Ingots", written in collaboration with Dr. Voya Kondic, and "Engineering Steels"—a revised and greatly enlarged version of the earlier book, written in joint authorship with Dr. W. I. Pumphrey—were published in 1953.

In 1924 Dr. Aitchison was awarded the Crompton Medal by the Institution of Automobile Engineers, and in the following year the Smith's Prize by the same Institution. In 1934, the Simms Gold Medal was awarded to him by the Royal Aeronautical Society, in recognition of his work on aeronautical materials, and he received a second award of the Simms Gold Medal in 1947. He is the only person who has received this award on two occasions.

Dr. Aitchison was elected a member of the Institute of Metals in 1918, served on the Council from 1947 to 1949, and in the latter year was made an Honorary Member. He is a Member of the Institution of Mechanical Engineers, a Fellow of the Royal Institute of Chemistry, a Fellow of the Royal Aeronautical Society (on whose Council he has also served), and a Fellow of the Institution of Metallurgists.

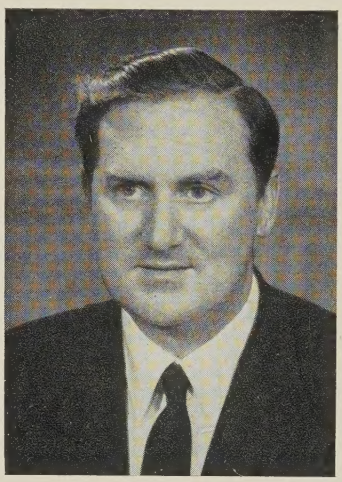
Professor A. H. Cottrell

(Rosenhain Medallist 1954)

Alan Howard Cottrell was born in 1919 and educated at Moseley Grammar School and the University of Birmingham. Here he gained the B.Sc. degree, with First Class Honours in Metallurgy, in 1939 and the Ph.D. in 1942.

From 1939 to 1945 he was engaged on research, mainly in connection with the welding of tank armour. He was appointed a Lecturer in Metallurgy at Birmingham in 1943, and he subsequently assisted the late Professor Hanson in planning a School of Physical and Theoretical Metallurgy. In 1949 he was appointed to his present position of Professor of Physical Metallurgy.

Since 1945 Professor Cottrell's researches have been mainly concerned with plastic deformation of metal crystals, a



subject to which he has made important contributions in papers published in the Institute's *Journal* and elsewhere. He has also lectured extensively. He made lecture tours in the United States in 1950 and 1953; he was guest lecturer at the University of the Witwatersrand, Johannesburg, in 1952, and at the University of Louvain, Belgium, in 1953. He presented a paper at the Ninth International Solvay Conference on Physics at Brussels in 1951 and delivered the 1953 R. S. Williams Lectures at the Massachusetts Institute of Technology.

Professor Cottrell is a member of the Inter-Service Metallurgical Research Council and Chairman of its Basic Properties of Metals Committee. He is also Associate Editor, for Great Britain, of *Acta Metallurgica*, and he is the author of two books: "Theoretical Structural Metallurgy" (1948) and "Dislocations and Plastic Flow in Crystals" (1953). He became a member of the Institute in 1938, and has served on its Metal Physics and Publication Committees.

THE TRAINING OF METALLURGISTS FOR INDUSTRY

A joint meeting of the Institute of Metals and the Institution of Metallurgists was held at The Royal Institution, London, on Friday, 27 November 1953 for an informal discussion on the training of metallurgists for industry. The morning session was allocated to the subject of education in universities, technical colleges, and apprentice schools, while the afternoon session was devoted to the practical training which can be provided by industry.

Education in Universities and Technical Colleges

In the first session the education of metallurgists was reviewed by speakers representing the universities and technical colleges, and accounts were given of the facilities provided by the National Foundry College and in an industrial school run by The Bristol Aeroplane Co., Ltd.

It was recognized that metallurgical education must be organized at different levels, and that it should be provided in a number of ways with the maximum degree of flexibility, bearing in mind the need to cater for local conditions in different kinds of industries. Nevertheless, the greater part of the discussion related to university courses, and very little emerged that was new. It was stressed that a great change had taken place in recent years in the academic approach to metallurgical courses, which were no longer descriptive but provided a rigorous fundamental training in which the problem was to decide what could be left out rather than what extra could be put in. The urge now was to explain rather than to describe.

Speakers in the discussion complained that graduates were far more theoretical than practical, being able to explain everything but unable to do anything; they had no critical faculty to decide whether the foundations upon which their particular explanations were based were true. It was also asserted that graduates wishing to carry out research were not taught to use their hands and, in consequence, they were considerably lacking in the experimental techniques so essential to the research worker.

Reference was made to the fact that adverse comparisons had been drawn between higher technological education in the U.S.A. and in Great Britain, particularly with regard to the provision of advanced courses of study rather than research, and this has led to the setting up of post-graduate schools of advanced study in Birmingham, London, and Sheffield, especially for metallurgists with industrial experience. The organization of these schools had made heavy demands on the staffs of the universities concerned, but the response from industry had been very poor, and it was feared that if additional support were not forthcoming these schools would have to disappear. Representatives from industry did not, however, take up the invitation to discuss this topic.

On the subject of part-time education, the necessity for a graduated series of qualifications was admitted, but there was no reply to the query "Does industry require its technologists to have a good knowledge of the fundamental sciences, or is it content to have men with a nodding acquaintanceship with them?" On the whole, opinion tended to the view that all educational courses should lead towards the qualification of Associateship of the Institution of Metallurgists (A.I.M.), and it appeared that the possible advantages of providing a metallurgical training for men who were not able to meet the academic requirements for intermediate science standard in mathematics, physics, and chemistry were not envisaged.

Attention was drawn to the difficulties which the technical colleges had in securing teaching staff. There was a demand for lectures of post-graduate standard on specialized subjects, and it was thought that industry might have given more assistance to the technical colleges by releasing specialists as lecturers for courses of this kind and also by allowing members of their staffs to act as part-time lecturers in the ordinary college courses. It was thought that the demand for advanced courses was such that consideration might be given to daytime tuition, lasting from three days to a fortnight, this having the advantage, as compared with evening lectures, that students might be brought together from all parts of the country. Similarly, at a lower level, the suggestion was made that there was scope for sandwich courses of the type requiring alternate six-month periods in college and in industry over a total of two or three years, with the proposal that these might be used by industry for the higher education of members of staff who had already shown promise in part-time day and/or evening classes.

Concern was expressed that there was a shortage of metallurgists of graduate status, and while some thought the number could be increased only by "poaching" from other sciences or other faculties—either by transfers of undergraduates or by the provision of post-graduate courses for those who had taken their degrees in subjects other than metallurgy—others were of the opinion that means would have to be found for indicating to schoolmasters and boys the scope and value of metallurgy as a profession.

Practical Training Which Can be Given by Industry

In general, the recommendations of the Joint Committee on Metallurgical Education ("The Education and Training of Metallurgists", September 1952) were approved; namely, that the training of graduates entering industry should be the responsibility, in each organization, of a particular individual who would ensure that each case was treated on its merits and that each man was given opportunities to assimilate the practical knowledge he needed. It was felt that the graduate should be given positive responsibility and a definite job as soon as possible, but that he should also be given opportunities for enlarging his knowledge of the organization and techniques of the industry he had entered while carrying out the initial tasks to which he had been assigned. Although it was thought to be impracticable to lay down a curriculum of formal training for graduates entering industry, some firms apparently preferred them to begin their industrial careers in the laboratory, either on routine or research work, and develop from that point.

It was stated that graduate metallurgists did not sufficiently appreciate that they began to learn only when they entered industry; they differed from members of some other professions in that they expected a job of some importance immediately after qualifying, whereas engineers, for example, served an apprenticeship after taking their degrees. Another speaker, supporting the suggestion that metallurgists should serve an apprenticeship, expressed the view that too many expected to enter a cadet class on leaving the university.

These remarks led to a lengthy exchange of views on the attitude of industry to graduates entering from the university, and the converse; it was alleged on the one hand that graduates needed more careful treatment and greater encouragement than they received at present, and on the other hand that there was too much "feather-bedding", coupled with graduates' expectations being set too high in respect of salary, prospects, and the attitude of others towards them. The reply was that, in general, students realized that, when they finished their course at the university, they still had much to learn and, in consequence, they did not have an exaggerated idea of their own importance; at the same time, it would be most unfortunate if they went into industry with a strong inferiority complex, as this would markedly reduce their potential value for the future. An important point raised here was that students differed enormously from one another, since some could easily be absorbed into industry, whereas others of a different temperament were assimilated only with difficulty.

The importance of well-planned vacation courses was stressed by several speakers, with emphasis on the necessity for the student to imbibe the industrial atmosphere. Industrialists suggested that there was a tendency for students to reduce their vacation courses to the minimum length, whereas they should endeavour to make them as long as possible, even at some sacrifice of holidays.

During the afternoon's discussion the unanimous feeling of the meeting was that further co-operation between the teaching profession and industry was essential if progress was to be made. This aspect of the subject might well be summed up in the words of a speaker who said: "I would entirely agree that there is not sufficient give and take between the two sides to enable us both—you on your side and we on ours—to know what the other side would like and how best to make use of the undoubted spirit of goodwill that exists. That is one of the things we ought to explore further to see whether we cannot arrive at closer co-operation".

Written contributions to the discussion underlined certain of the points raised during the meeting, more particularly with reference to shifting the emphasis on academic instruction to enable a man more fittingly to play his part in industry and the positive encouragement of graduates by university staffs to seek their future on the industrial side rather than in the Civil Service or university research, because only by the greater use of highly trained people could industrial productivity be improved and economic problems solved.

One contributor stressed the value of practical works' training for graduates, even for those who were to go into the research laboratories of an industrial establishment for their main career. The writer here envisaged practical courses in all departments as an operative, whereas, on the other hand, another contributor proposed a post-graduate course to prepare graduates for life in industry. The course envisaged basic instruction in: (1) the time factor, (2) the cost factor, (3) the human factor, (4) utilizing information services to explore new subjects, and (5) communication of specialist information to business executives in both oral and written form.

It was thought that a course of this nature would encourage students to enter industry and enable them more readily to co-operate with employers. This was of importance because more scientific staff had to be absorbed into small firms (which were responsible for the bulk of the production in this country), and the difficulties were greater than in the large industries, where tradition and practice now favoured their assimilation.

NEWS OF LOCAL SECTIONS AND ASSOCIATED SOCIETIES

Birmingham Local Section

The Birmingham Local Section Committee made a new departure last year by arranging a Christmas lecture to pupils of the local Grammar Schools. The lecturer was Dr. J. W. JENKIN (General Manager, Department of Development and Research, Tube Investments, Ltd.), whose subject was:

Something About Metals

At the beginning of his lecture Dr. Jenkin explained that two-thirds of the elements are metallic and that during extraction it was usual, sooner or later, to melt the metal. The effect of alloying on the melting point was described for alloys of copper and nickel and alloys of tin and lead. A simplified description of the mechanism of solidification and the formation of "crystals" was used to introduce two of the metallurgist's most useful tools, the microscope and the X-ray tube. These were described briefly, and the results obtained were shown by slides. This led to a brief description of cubic lattices and the principles of alloying. The effect of various treatments was demonstrated with the assistance of members of the audience who attempted to bend aluminium and alloy strip, to show the effect of alloying, and brass rod, to show the effect of annealing. Specimens of steel and amalgamated aluminium were used to show the effect of oxidation, and eventually a piece of hard-rolled brass was season-cracked by one of the demonstrators after a member of the audience had been unsuccessful. An excellent dilatometric demonstration of the transformation of steel on heating and cooling was used to introduce a demonstration of the hardening of steel wire by quenching and the transformation of austenitic stainless steel by cold working. The stress/strain diagram was described and the different Young's moduli of aluminium, brass, and steel were indicated by their deflection under load. A member of the audience cut aluminium and hard steel with a hacksaw to show their difference in hardness and gave a fine firework display by cutting a piece of cerium alloy. The lecture concluded with a discussion of strength: weight ratio, and the difference in specific gravity was shown by equal masses of uranium and aluminium.

Mr. H. H. SYMONDS acted as Chairman, and in his introductory remarks referred to the fact that the lecture had arisen from a suggestion made by Mr. R. Chadwick that the Local Section should, by means of a Christmas lecture, introduce the subject of metallurgy to schoolboys. The lecture was enthusiastically received and lectures of this kind may well become a permanent feature of the Section's activities.

Annual General Meeting

The Annual General Meeting of the Section will be held on Thursday 8 April, at the Imperial Hotel, Temple Street, Birmingham, and not on 4 May as previously announced. At this meeting Mr. H. H. SYMONDS will give his Chairman's Address.

At the meeting of the Section arranged for 1 April, a lecture on "Chromium and Its Alloys" will be given by Dr. A. H. SULLY, of the Fulmer Research Institute.

London Local Section

At a meeting of the Section held at 4 Grosvenor Gardens, London, S.W.1, on 7 January 1954, Mr. F. KING (Works Metallurgist, Northern Aluminium Co., Ltd., Rogerstone) gave a lecture on:

The Rogerstone Continuous Strip Mill

After a brief review of the history of the Rogerstone Mill of the Northern Aluminium Co., Ltd., the sequence of operations from the receipt of raw material to the despatch of finished products was outlined, and reference was made to some of the problems encountered in the production of sheet and strip.

The equipment for melting and for the semi-continuous casting of rolling ingots was briefly described, with special reference to the L.F. furnaces used for melting light process scrap and swarf.

Slides were shown illustrating preheating furnaces, two-high reversing hot mills, used for the initial stages of hot rolling, and of the two four-high mills used in tandem for the final hot rolling of slab.

Cold-rolling mills, slitting equipment, the continuous coil-annealing furnace, and the four-high temper mill were described, and the mechanical equipment used for handling coils was commented upon.

The first part of the lecture concluded with a description of the finishing operations for the production of container sheet, foil stock, and corrugated sheet.

The semi-continuous casting of ingots, scalping, preheating, hot and cold rolling, degreasing, cutting to length, and inspection operations were then illustrated by means of a film.

Scottish Local Section

At a meeting held in Glasgow on 14 December 1953, Dr. P. T. GILBERT (Head of the Corrosion Section, British Non-Ferrous Metals Research Association) read a paper entitled:

Corrosion, Particularly under Marine Conditions

The corrosion of various metals in the atmosphere was discussed with particular reference to the behaviour of steel, zinc, aluminium, and copper. Rates of attack in industrial, marine, rural, and tropical atmospheres were quoted, and the correlation between the rates of corrosion of steel and of zinc with atmospheric SO_2 content was pointed out. The beneficial effect of small amounts of copper in steel on the corrosion behaviour was mentioned, and the behaviour of some zinc-, copper-, and aluminium-base alloys was described. The various methods of protecting steel by metallic coatings were outlined. The principles of corrosion in immersed conditions were briefly referred to, and the corrosion in sea-water of aluminium alloys, steel, and copper alloys was discussed.

The dangers arising from bimetallic contacts were emphasized, and the value of cathodic protection as a method of protecting steel exposed to sea-water was pointed out. The precautions necessary to ensure good results from the use of aluminium in marine environments were mentioned. The corrosion of copper-base alloys in sea-water was illustrated by reference to the behaviour of materials in condenser systems. Dezincification and impingement attack were described, and methods of overcoming corrosion in condensers were briefly touched upon. Of foremost importance was the development of resistant materials such as aluminium brass and cupro-nickels containing iron.

JOINT ACTIVITIES

Capper Pass Awards

The Capper Pass Awards, which are made annually from a sum of £200 placed each year at the disposal of the Councils of the Institution of Mining and Metallurgy and of the Institute of Metals, by the Directors of Capper Pass and Son, Ltd., Bristol, are intended to encourage the publication of papers in the *Transactions of the Institution of Mining and Metallurgy* and in the *Journal of the Institute of Metals* on processes and plant used in extraction metallurgy and on the subject of assaying, and of papers on processes and plant used in all branches of the non-ferrous metal industry.

Provided that the Adjudicating Committee is satisfied that the quality and numbers of papers submitted, of the types for which the awards are made, reach a suitable standard:

(*a*) £100 per annum is available for one or more awards to authors of papers on some aspect of non-ferrous extraction metallurgy, including assaying;

(*b*) £100 per annum is available for one or more awards to the authors of papers relating to some processes or plant used in the extraction or fabrication of non-ferrous metals.

The Adjudicating Committee meets annually to consider, on behalf of the two societies, papers published during the past calendar year in the two journals referred to above. It may, at its discretion, make no award or awards of less than the money available, if, in its opinion, the quality or number of papers submitted in any year fails to reach a suitable standard. Any sums not awarded will be carried forward to future years.

The Councils of the Institution of Mining and Metallurgy and of the Institute of Metals hope that the generous offer made by Messrs. Capper Pass and Son, Ltd., will stimulate the writing of many papers of the types for which the awards are to be made. Papers on extraction metallurgy should preferably be submitted to the Institution of Mining and Metallurgy, while those on processes and plant used in the fabrication of non-ferrous metals should preferably be offered to the Institute of Metals. Both societies are prepared to accept papers from non-members.

Authors should note that applications should not be addressed to the Adjudicating Committee requesting that their papers should be considered for the Award of a Premium. All papers published by both societies will be examined by the Committee annually, and notices of the Awards will be published in the journals of the two societies and in the Press.

Mond Nickel Fellowships

The Mond Nickel Fellowships Committee now invites applications for the award of Mond Nickel Fellowships for the year 1954. Awards will be made to selected applicants of British nationality, educated to University degree or similar standard, though not necessarily qualified in metallurgy, who wish to undergo a programme of training in industrial establishments. They will normally take the form of travelling Fellowships, though awards for training at Universities may be made in special circumstances. There are no age limits, but awards will seldom be given to persons over 35 years of age. Each Fellowship will occupy one full working year. The Committee hope to award up to five Fellowships each year of an approximate value of £900 to £1200 each.

Mond Nickel Fellowships will be awarded in furtherance of the following objects:

(*a*) To allow selected persons to pursue such training as will make them better capable of applying the results of research to the problems and processes of the British metallurgical and metal-using industries.

(*b*) To increase the number of persons who, if they are subsequently employed in executive and administrative positions in the British metallurgical and metal-using industries, will be competent to appreciate the technological significance of research and its results.

(*c*) To assist persons with qualifications in metallurgy to obtain additional training helpful in enabling them ultimately to assume executive and administrative positions in British metallurgical and metal-using industries.

(*d*) To provide training facilities whereby persons qualified in sciences other than metallurgy may be attracted into the metallurgical field and may help to alleviate the shortage of qualified metallurgists available to industry.

Applicants will be required to state the programme of training in respect of which they are applying for an award, and to give particulars of their education, qualifications, and previous career. Full particulars and form of application can be obtained from: The Secretary, Mond Nickel Fellowships Committee, 4 Grosvenor Gardens, London, S.W.1. Completed application forms are required to reach the Secretary of the Committee not later than 1 June 1954.

NEWS OF KINDRED SOCIETIES

Instituto del Hierro y del Acero

The third General Assembly of the Instituto will be held in Madrid at the end of 1954. In order to give visitors from abroad some idea of the present state of the metallurgical industry in Spain, it is proposed that immediately before the Assembly visitors shall spend two days either in Barcelona or in Bilbao inspecting works in the respective regions. All participants will then proceed to Madrid for the main meeting. Further details will be announced later.

OTHER NEWS

Short Course for Teachers of Metallurgy

The Ministry of Education is arranging a Short Course in Metallurgy for teachers from Technical Colleges, to be held from 14–24 July 1954. The course will deal with modern metallographic techniques, mechanical and thermal treatment, modern methods of analysis, and radiographic techniques. Members of the course will take two of these sections, and must express their preference on the form of application. The work will be mainly practical, but there will be certain main lectures which all will attend.

Through the co-operation of the Staffordshire Local Education Authority and the Governors of the College, the main lectures and practical work will be carried out at the County Technical College, Wednesbury.

The course will be residential, but a limited number of local teachers may be accepted as day students. Through the kindness of the Governors of the National Foundry College, members will reside at the College Hostel, Tor Lodge, Mount Road, Tettenhall Wood, Compton, Staffordshire. The charge, for board, lodging, and transport between the hostel and the Technical College for the period from dinner on the evening of 14 July to breakfast on 24 July, will be £13, which will include lunch at the County Technical College, Wednesbury.

No fee will be charged for tuition. Subject to regular attendance and compliance with the rules for the course, the Ministry will assist towards travelling expenses necessarily incurred in attending the course by teachers in grant-aided service and in schools recognized as efficient. The amount of assistance will in general be limited to third-class rail fare by the cheapest route less 10*s*. Full particulars will be notified to selected students.

Forms of application for admission (Form 106 TSC) are obtainable from Local Education Authorities. Completed forms should reach the Ministry, in accordance with the directions on the form, not later than 15 May 1954.

Congrès de l'Aluminium

Celebrations to mark the centenary of the first production of aluminium on a commercial scale in 1854, by Henry Sainte-Claire Deville, are being organized by L'Aluminium Français and the Société Chimique de France. The "Congrès de l'Aluminium", as the celebrations will be called, is to be held in Paris on 14–19 June 1954, under the Presidency of Professor Albert Portevin.

The provisional programme is as follows:

Monday, 14 *June*.—Meeting at the Sorbonne in honour of Sainte-Claire Deville.

Tuesday and Wednesday, 15 *and* 16 *June*.—Discussions on papers dealing with the metallurgy of aluminium, the chemistry and physical chemistry of aluminium compounds, the technology and uses of the metal and its alloys. (The papers will be in English or French.)

Thursday, 17 *June*.—Visits to works and laboratories in and around Paris.

Friday and Saturday, 18 *and* 19 *June*.—Visits to plants in other parts of France.

In connection with the Congrès, an exhibition is being arranged by L'Aluminium Français, which will be open from 10 June to 15 August. It will be held on the banks of the Seine, and will include working models showing the manufacture and use of semi-fabricated products.

Members who are interested in this Congrès or who wish to submit papers may obtain further details from Centre Technique de l'Aluminium, 87 Boulevarde de Grenelle, Paris (15e).

International Congress on Surface-Active Compounds

An international congress on surface-active compounds is being organized by the French trade association Chambre Syndicale Nationale des Transformateurs de Matières Grasses et Fabricants de Produits Auxiliaires (Tramagras). It will be held at the Sorbonne in Paris from 30 August to 5 September 1954, and will be under the Presidency of Professor Trefouel, Director of the Pasteur Institute.

The Congress will deal with the production and properties of surface-active compounds and with their application in many branches of industry, including metal cleaning. Details may be obtained from the Director of Tramagras, 70 Champs-Elysées, Paris (8e).

NOTICE TO AUTHORS OF PAPERS FOR THE "JOURNAL" AND CONTRIBUTORS TO DISCUSSIONS

1. **Papers will be considered for publication from non-members as well as members of the Institute.** They are accepted for publication in the *Journal* and not necessarily for presentation at any meeting of the Institute. MSS. should be addressed to The Editor of Publications, The Institute of Metals, 4 Grosvenor Gardens, London, S.W.1.

2. **Papers suitable for publication** may be classified as:

(*a*) Papers recording the results of original research.

(*b*) First-class reviews of, or accounts of progress in, a particular field.

(*c*) Papers descriptive of works methods, or recent developments in metallurgical plant and practice.

(*d*) Papers in classes (*a*), (*b*), and (*c*) above, previously published in languages other than English, French, German, or Italian, if of sufficient merit.

3. **Manuscripts and illustrations** should be submitted in duplicate. MSS. must be typewritten (*double-line spacing*) on one side of the paper only, and authors are requested to sign a declaration that neither the paper nor a substantial part thereof has been published elsewhere. Exceptions may be made in certain cases where a paper has been published in a language other than English, French, German, or Italian (see 2(*d*) above). MSS. not accepted are normally returned within 6 months of receipt.

In the interests of economy, all papers must be written as concisely as possible; in general, internal research reports are not in suitable form for publication as papers in the *Journal*. All but the simplest mathematical expressions should be written by hand, with capital and small letters clearly distinguished. Superscript and subscript letters should also be plainly indicated. Greek letters and special signs should be identified in the margin. For style, spelling, and abbreviations used, any recent issue of the *Journal* may be consulted.

4. **Synopsis.** Every paper must have a synopsis (not exceeding 250 words in length) which, in the case of a paper reporting original research, should state its objects, the ground covered, and the nature of the results. The synopsis will appear at the beginning of the paper, and should be in a form suitable for use by abstracting organizations. Extracts from a "Guide for the Preparation of Synopses" drawn up by the Abstracting Services Consultative Committee are reproduced below.

5. **References** must be collected at the end of the paper and must be numbered in the order in which they occur in the MS. Initials of authors must be given, and the Institute's official abbreviations for periodical titles (as used in *Metallurgical Abstracts*) should be employed, where known. References to papers should be set out in the style:

A. L. Dighton and H. A. Miley, *Trans. Electrochem. Soc.*, 1942, **81**, 321 (i.e. year, volume, page).

References to books should be in the following style:

C. Zener, "Elasticity and Anelasticity of Metals". Chicago: **1948** (University of Chicago Press).

6. **Illustrations.** Each illustration must have a number and description; only one set of numbers must be used in one paper, and it is desirable to number the half-tone illustrations consecutively, rather than to intersperse them with the line figures. The captions should be typed on a separate sheet.

The set of **line figures** sent for reproduction must be drawn (about twice the size to appear in the *Journal*) in Indian ink on smooth white Bristol board, good-quality drawing paper, co-ordinate paper, or tracing *cloth*, which are preferred in the order given. Co-ordinate paper, if used, must be blue-lined, with the co-ordinates to be reproduced finely drawn in Indian ink. Curves should be drawn boldly (i.e. at least twice the thickness of the frame). Experimental points should be indicated by open or closed circles, triangles, squares, &c. (preferably not crosses). Curves should be broken on each side of such symbols and plenty of allowance should be made for closing up in blockmaking. All lettering and numerals, &c., should preferably be in *pencil*, so that the Institute's standard lettering may be affixed, and ample margins must be left outside the framework of the figures to enable this to be done. The second set of line illustrations may be photostat copies.

Photographs must be restricted in number, owing to the expense of reproduction, and photomicrographs should be trimmed to the smallest possible of the following sizes consistent with adequate representation of the subject: 4 in. deep by 3 in. wide: 2 in. deep by 3 in. wide: 2 in. square. Magnifications of photomicrographs must be given in each case. Photographs for reproduction should be loose, not pasted down (and not fastened together with a clip, which damages them), and the figure number and author's name should be written on the back of each. Captions should be given to the photomicrographs, but these should be kept as brief as possible.

Because of the present high cost of printing and paper it is imperative that authors restrict illustrations (particularly photographs) to the absolute minimum deemed necessary to support their argument. Only in exceptional cases will illustrations be reproduced if already printed and readily available elsewhere.

7. **Tables or Diagrams.** Results of experiments, &c., may be given in the form of tables *or* figures, *but* (unless there are exceptional reasons) *not both*. Tables should bear Roman numbers, and each should have a heading that will make the data intelligible without reference to the text.

8. **Corrections.** A certain number of corrections in proof are inevitable, but any modification of the original text is to be avoided. Since corrections are very expensive, the Institute reserves the right to require authors to contribute towards their cost if the Editor deems them to be excessive. The Institute also reserves the right to require a contribution to the cost of remaking any block where this is necessitated by an error on the author's part.

9. **Reprints.** Individual authors are presented with a maximum of 25, and two or more authors with a maximum of 50 reprints from the *Journal*, without covers. Limited numbers of additional reprints can be supplied at the author's expense, if ordered before proofs are passed for press. (Orders should preferably be placed when submitting MSS.)

10. **Discussion.** Except in the case of special symposia, shorthand records of discussions are not taken at meetings. Written discussion may be submitted on any paper, preferably typewritten (*double-line spacing*). References should be given in the form of footnotes. Paragraphs 6 and 7 above are also applicable to such contributions. Reprints of discussion cannot be supplied to contributors.

GUIDE FOR THE PREPARATION OF SYNOPSES

(*As recommended by the Abstracting Services Consultative Committee*)

1. **Purpose.** The synopsis is not part of the paper; it is intended to convey briefly the content of the paper, to draw attention to all new information, and to the main conclusions. It should be factual.

2. **Style of writing.** The synopsis should be written concisely and in normal rather than abbreviated English. It is preferable to use the third person. Where possible use standard rather than proprietary terms, and avoid unnecessary contracting.

It should be presumed that the reader has some knowledge of the subject, but has not read the paper. The synopsis should therefore be intelligible in itself without reference to the paper; for example, it should not cite sections or illustrations by their numerical references in the text.

3. **Content.** The title of the paper is usually read as part of the synopsis. The opening sentence should be framed accordingly and repetition of the title avoided. If the title is insufficiently comprehensive, the opening should indicate the subjects covered. Usually the beginning of a synopsis should state the objective of the investigation.

It is sometimes valuable to indicate the treatment of the subject by such words as: brief, exhaustive, theoretical, &c.

The synopsis should indicate newly observed facts, conclusions of an experiment or argument and, if possible, the essential parts of any new theory, treatment, apparatus, technique, &c.

It should contain the names of any new compound, mineral species, &c., and any new numerical data, such as physical constants; if this is not possible, it should draw attention to them. It is important to refer to new items and observations, even though some are incidental to the main purpose of the paper; such information may otherwise be hidden, though it is often very useful.

When giving experimental results the synopsis should indicate the methods used; for new methods the basic principle, range of operation, and degree of accuracy should be given.

4. **References.** If it is necessary to refer to earlier work in the summary, the reference should always be given in full and not by number. Otherwise references should be left out.

When a synopsis is completed, the author is urged to revise it carefully, removing redundant words, clarifying obscurities, and rectifying errors in copying from the paper. Particular attention should be paid by him to scientific and proper names, numerical data, and chemical and mathematical formulæ.

DIARY

Local Sections and Associated Societies

15 March. Sheffield Local Section. "Some Factors Affecting Spring Design", by Dr. W. R. Berry. (Joint meeting with the Sheffield Society of Engineers and Metallurgists.) (Mappin Hall, St. George's Square, Sheffield, at 7.30 p.m.)

16 March. North East Metallurgical Society. "Some Factors Influencing Basic Open Hearth Productivity", by T. F. Pearson. (Cleveland Scientific and Technical Institution, Middlesbrough, at 7.15 p.m.)

16 March. South Wales Local Section. Annual General Meeting. (University College, Metallurgy Department, Singleton Park, Swansea, at 6.45 p.m.)

18 March. Liverpool Metallurgical Society. Conversazione. (Liverpool Engineering Society, The Temple, Dale Street, Liverpool, at 7.0 p.m.)

30 March. Oxford Local Section. Annual General Meeting, followed by a discussion. (Oak Room, Cadena Café, Cornmarket Street, Oxford, at 7.0 p.m.)

1 April. Birmingham Local Section. "Chromium and Its Alloys", by Dr. A. H. Sully. (James Watt Memorial Institute, Great Charles Street, Birmingham 3, at 6.30 p.m.)

1 April. Leeds Metallurgical Society. "Bearings and Bearing Alloys", by R. T. Rolfe. (Chemistry Department, The University, Leeds 2, at 7.15 p.m.)

1 April. London Local Section. Annual General Meeting, followed by Discussion on "The Brittle Fracture of Metals". Opening speakers: Dr. L. Northcott, on "Molybdenum", Dr. A. H. Sully, "Manganese and Chromium", and Dr. A. A. Wells, "Theoretical Aspects". (4 Grosvenor Gardens, London, S.W.1, at 6.30 p.m.)

8 April. Birmingham Local Section. Annual General Meeting and Chairman's address by Mr. H. H. Symonds. (Imperial Hotel, Temple Street, Birmingham, at 6.30 p.m.)

8 April. Liverpool Metallurgical Society. Annual General Meeting, followed by "The Cold Working of Metals", by J. G. Wistreich. (Joint meeting with the Iron and Steel Institute and the North Wales Metallurgical Society.) (Liverpool Engineering Society, The Temple, Dale Street, Liverpool, at 7.0 p.m.)

Other Societies

11 March. Institute of Metal Finishing, North-West Branch. "Costing in the Plating Shop", by A. Walmsley. (Engineers' Club, Albert Square, Manchester, at 7.30 p.m.)

12 March. Chemical Society, Birmingham Section. "Friction and Lubrication" by Dr. D. Tabor. Joint Meeting with Birmingham University Chemical Society. (Chemistry Department, The University, Birmingham 15, at 4.30 p.m.)

12 March. Institute of British Foundrymen, Southampton Section. "Propeller Manufacture", by J. M. Langham. (Southampton Technical College, St. Mary Street, Southampton, at 7.0 p.m.)

15 March. Institute of Metal Finishing, London Branch. "Recent Developments Concerning Electroforming Moulds", by P. Spiro. (Northampton Polytechnic, St. John Street, London, E.C.1, at 6.0 p.m.)

18 March. Institute of Welding, Medway Section. "Hydrogen *versus* Welding", by Dr. C. L. M. Cottrell. (Sun Hotel, Chatham, at 7.15 p.m.)

18 March. Institution of Mining and Metallurgy. General meeting. (Rooms of the Geological Society, Burlington House, Piccadilly, London, W.1, at 5.0 p.m.)

19 March. Institute of Petroleum. Symposium on Metal-Working Oils. (Institution of Electrical Engineers, Savoy Place, London, W.C.2, at 2.30 p.m.)

19 March. West of Scotland Iron and Steel Institute. "Selection of Materials for High-Temperature Steam Service", by G. G. Foster. (39 Elmbank Crescent, Glasgow, C.2, at 6.45 p.m.)

23 March. Institute of British Foundrymen, Slough Section. "Zinc Die-Castings", film and paper by the Zinc Alloy Diecasters' Association. (Lecture Theatre, High Duty Alloys, Ltd., Slough, at 7.30 p.m.)

23 March. Sheffield Metallurgical Association. "Analysis of Permanent-Magnet Alloys", by W. Wright. (B.I.S.R.A., Hoyle Street, Sheffield, at 7.0 p.m.)

26 March. Institute of Metal Finishing, Sheffield and North-East Branch. "Enigma of Chromium Plating", by N. A. Tope. (Fitzwilliam Room, Grand Hotel, Sheffield, at 6.30 p.m.)

26 March. North East Coast Institution of Engineers and Shipbuilders. "Cathodic Protection of Cargo Spaces in Oil Tankers", by J. Lamb and E. V. Mathias. (Mining Institute, Newcastle on Tyne, at 6.15 p.m.)

31 March. Institute of British Foundrymen, London Branch. "Any Questions" with Geo. C. Pierce in the Chair. (Waldorf Hotel, London, W.C.2, at 7.30 p.m.)

31 March. West of Scotland Iron and Steel Institute. "Engineering Problems Connected with the Installation and Commissioning of a Cross-Country Mill", by Dr. W. S. Walker. (Joint Meeting with Engineers' Group, Iron and Steel Institute.) (39 Elmbank Crescent, Glasgow, C.2, at 6.45 p.m.)

1 April. Institute of Welding, Medway Section. Annual General Meeting, followed by Films on "Welding of Nickel Alloys" and the "Aircomatic Process". (Sun Hotel, Chatham, at 7.15 p.m.)

6 April. East Midlands Metallurgical Society. "Wire Drawing", by R. S. Brown. (Nottingham and District Technical College, Shakespeare Street, Nottingham, at 7.30 p.m.)

6 April. Sheffield Metallurgical Association. "Preparation of the British Chemical Standards", by N. D. Ridsdale and P. D. Ridsdale. (B.I.S.R.A., Hoyle Street, Sheffield, at 7.0 p.m.)

8 April. Institution of Production Engineers, London Section. "Potentialities of Titanium", by J. C. Campbell. (Royal Empire Society, Northumberland Avenue (Craven St. entrance), London, W.C.2, at 7.0 p.m.)

13 April. Royal Aeronautical Society. "Some Aspects of Modern Aircraft Materials", by Dr. H. Sutton. (The Library, 4 Hamilton Place, London, W.1, at 7.0 p.m.)

13 April. Sheffield Metallurgical Association. "Powder Metallurgy as an Aid to Production", by G. R. Bell. (B.I.S.R.A., Hoyle Street, Sheffield, at 7.0 p.m.)

APPOINTMENTS VACANT

A PHYSICIST or Metallurgist is required for a team studying the continuous-casting process as applied to aluminium and aluminium alloys. The work includes studies of heat transfer, solidification, and fluid processes by conventional and analogue techniques and by applications of radioactive tracers. Some previous experience of heat-transfer investigations would be valuable, but the main requirements are mathematical competence and interest in an important problem in applied physics. The salary will depend on qualifications and previous experience. Please apply to: The Director of Research, Aluminium Laboratories, Ltd., Banbury, Oxon.

AS A RESULT of increased laboratory facilities, a vacancy exists in the Midlands for a SENIOR METALLURGIST responsible to the Chief Metallurgist. Applicants, between 30 and 35 years of age, with a First or Second Class Honours Degree and experience in casting and extrusion are invited to send particulars of experience and salary required to Box No. 362, Institute of Metals, 4 Grosvenor Gardens, London, S.W.1.

MINISTRY OF SUPPLY requires metallurgists for experimental establishments in South of England, for research and development work chiefly on corrosion, fatigue, high-temperature materials, and light-alloy technology. Appointments according to qualifications and experience as: (Ref. F29/54A) Assistant Experimental Officer, £264 (age 18)–£376; Experimental Officer, £649–£799—both requiring Higher School Cert. (science) or equivalent, although further training to standard of H.N.C., A.I.M., &c., may be an advantage; or (Ref. F30/54A) Scientific Officer, £417–£781, requiring 1st or 2nd class honours degree in metallurgy, or in physics or chemistry with bias to metallurgy. All appointments unestablished. Women's rates somewhat less. F.S.S.U. benefits may be available for S.O.'s. Application forms from M.L.N.S., Technical & Scientific Register (K), 26, King Street, London, S.W.1, quoting appropriate reference. Closing date 15 March, 1954.

THE METALS DIVISION of Imperial Chemical Industries, Ltd., invites applications from Chemists or Metallurgists to fill a vacancy in the Corrosion Section of its Research Department, Birmingham. Candidates should possess an honours degree or an equivalent qualification, and experience in corrosion research would be advantageous. A commencing salary of up to £1,100, dependent upon age, qualifications, and experience, will be paid to the successful candidate. Applications in writing should be addressed to the Assistant Staff Manager, I.C.I. Metals Division, Witton, Birmingham 6.

THE ASSOCIATED ETHYL COMPANY, LTD., Northwich, Cheshire, require an ELECTROCHEMIST or METALLURGIST to carry out investigations on corrosion and related problems, and on materials of construction. Applicants should not be over 35 years of age, should possess a good honours degree and preferably have some research experience. Salary will be according to age, qualifications, and experience. The successful applicant initially will be required to work at Northwich, but eventually will be stationed permanently at Ellesmere Port.

Applications should be addressed to the Personnel Manager at the above address.

ATOMIC ENERGY RESEARCH ESTABLISHMENT, Harwell, Berkshire, requires a METALLOGRAPHER with a good basic knowledge of metallurgy to work on problems arising from research on novel metals and processes. The candidate must be willing to take responsibility, and experience with a wide range of metals and alloys is desirable. He should be familiar with conventional metallographic methods and the principles underlying recently developed techniques. The post will be graded Experimental or Assistant Experimental Officer according to qualifications and experience. Salary scales: Experimental Officer approximately £650–£800; Assistant Experimental Officer approximately £335 (at 21)–£576. Applications, quoting 2/103/52, should be submitted to the Establishment Officer, A.E.R.E., within two weeks.

MULLARD BLACKBURN WORKS, LTD., require a METALLURGIST for their laboratory engaged in the development of magnetic materials. Duties will include work on permanent-magnet alloys. Applicants should possess a degree in Metallurgy, and some specialization in Physical Metallurgy would be an advantage. Apply in writing, giving full details of age, education, and experience, to the works Personnel Officer, Mullard Blackburn Works, Ltd., Philips Road, Blackburn. Please quote ref. M7/D.